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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/758,315

01/15/2004

Shih-Yen Tsai

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09/22/2004

STEPHEN B. ACKERMAN
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EXAMINER

SARKAR, ASOK K

ART UNIT

PAPER NUMBER

2829

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/758,315

Applicant(s)

TSAI ET AL.

Examiner

Asok K. Sarkar

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AK

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 15 January 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 3/19/2004.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1 – 5 are rejected under 35 U.S.C. 102(e) as being anticipated by Noguchi, US 2003/0114000.

Regarding claim 1, Noguchi teaches a method of copper metallization in the fabrication of an integrated circuit device comprising:

- providing an opening 16a through a dielectric layer 11b overlying a substrate 1S on a wafer with reference to Fig. 7;
- forming a copper layer 18a to completely fill said opening with reference to Fig. 8;
- forming a buffer zone on a surface of said copper layer with reference to Figs. 10, 13 and 14 (see paragraphs 232 – 234); and
- depositing a capping layer 15b, 11c overlying said copper layer and said buffer zone with reference to Fig. 17 to complete said copper metallization in said fabrication of said integrated circuit device.

Regarding claim 2, Noguchi teaches forming semiconductor device structures in

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and on said substrate 1S wherein said semiconductor device structures include gate electrodes 4, source/drain regions 6 and 7, and lower level metallization L1 with reference to Fig. 17.

Regarding claim 3, Noguchi teaches the opening is made to one of said semiconductor device structures within said substrate with reference to Fig. 7.

Regarding claim 4, Noguchi teaches depositing said capping layer is an in-situ process in paragraphs 210 and 211.

Regarding claim 5, Noguchi teaches said step of forming said copper layer is selected from the group consisting of: physical vapor deposition, chemical vapor deposition electroplating, and electroless plating in paragraph 214.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

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5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 6 and 8 – 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Noguchi, US 2003/0114000 in view of Schonauer, US 6,162,727.

Regarding claim 6, Noguchi fails to teach step of forming said buffer zone comprises applying F ions or controlled corrosion gas to said copper surface.

Schonauer teaches the step of forming said buffer zone comprises applying F ions on the copper surface in column 6, lines 39 – 58 for the benefit of preventing the formation of dendrites from the Cu in column 6, lines 44 – 46.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Noguchi and form the buffer zone additionally by applying F ions on the copper surface for the benefit of preventing the formation of dendrites from the Cu as taught by Schonauer in column 6, lines 44 – 46.

Regarding claims 8 and 14, all limitations of these claims have been described earlier in rejecting claims 1 and 6.

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Regarding claims 9 and 15, all limitations of these claims have been described earlier in rejecting claim 2.

Regarding claims 10 and 16, all limitations of these claims have been described earlier in rejecting claim 3.

Regarding claims 11 and 17, all limitations of these claims have been described earlier in rejecting claim 5.

Regarding claims 7, 13 and 20, Noguchi in view of Schonauer teaches the capping layer selected from silicon carbide or silicon nitride (see Noguchi, paragraph 210) but fails to teach thickness between 200 – 1000 Angstroms.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention to judiciously adjust and control this parameter during the device manufacture through routine experimentation and optimization to achieve optimum benefits (see MPEP 2144.05) and it would not yield any unexpected results.

Note that the specification contains no disclosure of either the critical nature of the claimed processes or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen methods or upon another variable recited in a claim, the Applicant must show that the chosen methods or variables are critical (*Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir., 1990)). See also *In re Aller, Lacey and Hall* (10 USPQ 233 – 237).

Regarding claims 12 and 18, Noguchi teaches the use of ammonia plasma treatment for solving the copper hillock problem by reducing the oxides and forming CuN layer (see paragraph 234). Schonauer also teaches that F ion treatment can

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reduce hillock/dendrite formation in copper alloy by removing the contaminants from the conductor surface.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to replace the fluoride treatment with the nitrogen/fluorine (NF₃) plasma treatment for the benefit of providing an environmentally clean dry atmosphere treatment without going to a polluting wet environment treatment. Additionally, fluorine plasma is routinely used for dry etching in the semiconductor industry.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Asok K. Sarkar whose telephone number is 571 272 1970. The examiner can normally be reached on Monday - Friday (8 AM- 5 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Tokar can be reached on 571 272 1812. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

8. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

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For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Asok Kumar Sarkar

Asok K. Sarkar

September 13, 2004

Patent Examiner